Go With the Flow: Engagement and Learning in Second Life

Karen Cooper
Naval Air Warfare Center Training Systems Division
Orlando, Florida
Karen.Cooper@navy.mil

ABSTRACT

The military recognizes digital technology's powerful potential to enhance training and desires to proactively explore emerging technology capabilities in order to remain on the forefront of serving our warfighter. Several branches of military service are currently developing virtual world technologies. One popular world is Second Life (SL) in which the Air Force is building a recruit environment; the Navy is developing training; and several Commands in Central Florida are developing a portal for training exploration.

Because of SL's global presence and popularity, it is perceived as a potentially powerful learning environment for serving our geographically dispersed military. In particular, it is professed to be a highly effective learning environment for younger generations that targets interactivity and engagement. However military training in these worlds has not been empirically tested. This paper presents results from a study investigating the relationship between engagement, achievement, and performance in SL.

The study was conducted on an Air Force SL island, developed for collaboration, teaming, and innovative research. One hundred participants completed the activity. A self-directed, inquiry-based activity, tagged a VWQuest, was taken from the web-based WebQuest instructional framework and adapted for virtual worlds. Data were collected including demographics, a multiple-choice quiz, performance measures, and engagement level using Csikszentmihalyi's Flow Theory.

Although no statistically significant relationship was found between engagement and recall ability, a relationship was found between engagement and overall performance, meaning that for this study's activity, an individual's overall level of engagement was able to statistically predict an individual's ability to perform. This finding suggests that having an engaging experience while learning in Second Life may in fact contribute to an individuals' ability to perform better. Additionally, Second Life skill level was found to be a precursor to engagement.

The results have significant implications for our military in terms of training, instructional design, and further research using these complex learning environments.

ABOUT THE AUTHOR

Karen Cooper is the branch head for the research & development networks at the Naval Air Warfare Center Training Systems Division (NAWCTSD), serving research and development networks. As a network engineer, she is a graduate of Navair's senior executive management program, the National Defense University's Information Assurance and Chief Information Officer's graduate certificate programs.

She is currently leading a NAWCTSD team in virtual world (VW) exploration, using Second Life (SL) as an initial world for investigation. She serves as the principle NAWCTSD technical point of contact for the joint Team Orlando VW efforts in Central Florida's Research Park. She also represents NAWCTSD across the Department of Defense (DoD) as the principle on VW investigation, collaboration, and partnering.

She holds a bachelor's in Math/Computer Science, a Master's in Information Management, and recently, a PhD in Instructional Technology from the University of Central Florida. Her dissertation research focused on the examination of engagement and its relationship to achievement and performance in SL. Research interests include emergent technologies including virtual worlds, Web 2.0, Web 3.0, and understanding the 21st century learner.

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Karen Cooper
Naval Air Warfare Center Training Systems Division
Orlando, Florida
Karen.Cooper@navy.mil

INTRODUCTION

The impact of technology is evident in all areas of life including work (Gronstedt, 2007), education (Johnson, Levine, & Smith, 2007) and leisure (Drotner, 2007). As issues of industrial globalization, rising costs of natural resources, and continued focus on business efficiencies continue to impact our society, technology continues to be targeted as a solution to these challenges.

A rapidly increasing collection of research can be found that addresses learning in various technology-based contexts, from formal online courses to informal contexts such as chat rooms (Hayes, 2006). Growth of online learning reveals that the number of students taking at least one online course is ten times greater than the head count enrollments in post-secondary education (Smith, Smith, Samors & Mayadas, 2008).

The military recognizes digital technology's powerful potential to enhance training and education, and desires to proactively explore emerging technology capabilities in order to remain on the forefront of serving our warfighter. Several branches of military service are currently exploring and developing training in immersive environments. Still, as they are met with new teaching platforms, many uncertainties surface such as a suitable design for technology-based instruction, student engagement, and appropriate metrics for assessing achievement.

As technologies continue to advance and become mainstream instructional tools, it becomes increasingly important to understand the dynamics and value of the more sophisticated technology options (Guru & Nah, 2001). Additionally, because educators and trainers desire their material to be received effectively and efficiently, it becomes necessary to understand the construct of student engagement in immersive environments and the impact on student achievement. The focus of this study involves an advanced technology, the virtual world of Second Life, and how it interrelates with student engagement, achievement, and performance.

For this study, achievement was defined to be a probe for factual content within the cognitive domain, measuring a participant's level of learning attainment using recognition and recall. Performance was defined to be a participant's level of learning attainment as measured by participation, initiative and effort.

VIRTUAL WORLDS

One popular online medium attracting a growing number of people is the social virtual world (Book, 2004; Hayes, 2006). Virtual worlds, computer-based simulated environments, are a synchronous, persistent network of people, represented as avatars, facilitated by networked computers (Bell, 2008). These worlds are characterized by a shared social space, a graphical user interface, real-time interaction, user-created content, persistence, and active support for in-world social groups (Book, 2004). Virtual worlds have immersion and social media functionality. They are not necessarily games as games have pre-defined rules and goals; virtual worlds may not always have specific rules and goals. They create new opportunities for learning, innovation and collaboration that go beyond the physical and geographical limitations of the physical world.

2D vs 3D Spaces

Within 2-dimensional (2D) online environments, typically thought of in terms of web pages, information is typically text-based and delivered on the page in a top down format. Although web 2.0 technologies offer interactivity and participation, they are still largely a unidirectional dissemination of information. That is, even when multimedia content is available, once it is presented, the audience is still predominantly passive.

In 3-dimensional (3D) environments, one has the perception of being fully immersed in the content. The information space surrounds the users' field of view. Through the persona of an avatar, users can touch and manipulate the environment around them.

The difference between 2D and 3D environments becomes significant in some settings. Using the 2D web space, because navigation is often completed through text-hyperlinks, users must understand the language and content of the link in order for it to be meaningful to them. In a 3D immersive environment, navigation is accomplished via movement. The person's avatar walks through a visual and auditory space. It becomes possible to learn by solely experiencing the area – the observation of virtual

structures and people. The potential to learn and experience is not dependent on knowing the language.

Virtual worlds offer a multi-sensory experience that cannot be found or is limited within the 2D web space. Instruction may potentially be enhanced through the visual, auditory, or tactile experience. They also offer a unique immersive experience with the presence of an avatar playing a key role. Dr. Paulette Robinson, Assistant Dean for the National Defense University and an instructional technology expert suggests the immersive nature of virtual worlds has a profound effect on cognition because of the avatar representation of oneself, implying that if a person is engaged while in-world, there is less of a distinction from one's brain between the person and the avatar (TSJ, 2008).

Instructional applications that may be useful enablers for learning within virtual worlds include 3D modeling, real-time collaboration, problem solving activities, and independent inquiry-based exercises. 3D modeling allows a student to better understand the content by using rotation and multidimensional perspectives. Real-time, synchronous collaboration is enhanced in several ways. For example, the visual appearance of an avatar as human representation may create a real sense of presence (Hornik, 2008). Self-directed learning activities like the activity used in this study combine student-centered constructs with inquiry-based design and exploration, allowing the user to control the time, location, and pace of their experience.

Potential positive outcomes from virtual world learning experiences may provide the opportunity to fail safely (Heinrichs, Youngblood, Harter & Dev, 2008), to operate cost-effectively and efficiently (TSJ, 2008), for more convenience (Helmer & Light, 2007), and enjoyment by the learner (KZERO, 2008). Capitalizing on these capabilities and affordances may offer powerful alternatives for teaching effectiveness, and these differences may have significant implications for extending and improving learning outcomes.

Second Life

Second Life™ (Linden Lab, 2003) is one of the more popular and widely used virtual worlds. It is one of over 150 different virtual worlds in existence today (KZERO, 2008). Although at first glance Second Life may seem like a computer game, it is not. It is a real-time, dynamically distributed environment. The primary capability is content creation. Second Life has a high-level, built-in scripting language and building tools, making it extremely easy to build content and create scripts. This allows users to build and create a

uniquely customized, personalized environment that could be suited for their specific purpose.

SL as a Learning Environment

Educators understand Second Life to be both a tool and a platform for today's learner. With over 1500 universities and 1500 educators currently in Second Life, Ondrejka (2007) believes academicians are the biggest trailblazers in virtual worlds.

The interest in using virtual worlds as a serious learning platform spans beyond academia. The public sector has become interested in understanding potential uses for these new environments. The United States military recognizes that rapidly evolving gaming and visualization technologies have potential to radically
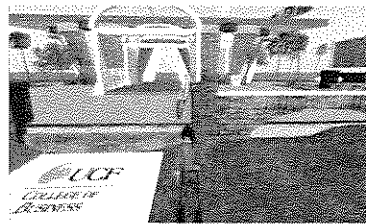
 change the way they approach training and education. Early interest and exploration is underway by several services, proving that the military understands the importance in remaining current with leading technologies and recognizes the rising global interest. Furthermore, efficiencies that may be gained by using virtual worlds for collaboration, data visualization, rapid prototyping, combat readiness training, or scenario training have piqued serious interest in our military.

The National Defense University (NDU) is a leader in the exploration of virtual worlds, currently focused on comparing and contrasting large-scale business virtual worlds. NDU believes there may be real economic value in virtual worlds for the Department of Defense (DoD). Dr. Paulette Robinson, Assistant Dean for the University, commented that she gave a presentation to a Canadian audience where everyone was represented in Second Life, and the event saved the university $2500 per person in airfare (TSJ, 2008).

Training and education of our servicemen is a large and important part of our military's focus. Following the lead from the academic community, the military is interested in teaching efficiently by taking advantage of remotely available, globally accessible, and massively scalable training opportunities. Additionally, simulated training scenarios allow the military to train in a fail-safe environment as well as create simulations that would otherwise not be affordable or feasible for training in real life.

The U.S. Army National Guard has contracted for the development of a virtual world for emergency management and preparedness training. The National Aeronautics and Space Administration (NASA) has built a presence in Second Life to engage today's high school and college students and to develop their interest in math and science careers.

The U.S. Air Force is developing a comprehensive 21st century Air Force training program that includes new recruits receiving an avatar that remains with them for the duration of their service career (TSJ, 2008).

Many virtual worlds such as Second Life are cost effective, real-time and globally available. Moreover, they are believed to be a powerful medium for creating instruction and have been used as an educational strategy (ANGEL Learning, 2008). Yet in addition to educators striving to create a pedagogically sound learning environment, both educators and learners desire the learning content to be engaging.

THEORETICAL DEVELOPMENT

Engagement can be viewed as "the amount of physical and psychological energy that the student devotes to the academic experience" (Astin, 1984). Student engagement may be associated with increased time on task, and the development of deep learning, resulting in better classroom performance (Hornik, 2008). Student engagement has been associated with important learning outcomes including increased performance, satisfaction and retention (Chen, Gonyea, & Kuh, 2008). One way to measure student engagement is through the experience of flow.

Flow is defined as an intrinsically motivated optimal state characterized by intense concentration and enjoyment. It is the holistic positive sensation people feel when they act with total involvement, concentration, and immersion (Csikszentmihalyi, 1975, 1990). When in the state of flow, people become absorbed in the activity, tuning out most everything else. Csikszentmihalyi & Larson (1987) identified the following nine elements accompanying an experience of flow: (1) clear, attainable goals, (2) direct and immediate feedback, (3) balance between activity challenge and individual skill, (4) high degree of concentration, (5) merging of action and awareness, (6) temporary loss of time, (7) temporary disappearing of self-consciousness, (8) sense of personal control, and (9) an autotelic, intrinsically rewarding experience. Flow theory then, posited by Csikszentmihalyi (1975, 1990, 1997), is a theory that describes the immersed state that exists in an individual premised by the above elements.

Flow theory has been shown to be effective in areas such as organizational effectiveness (Cassidy, 2006), video games (Belchior, 2007), athletics (Jackson & Marsh, 1996), and music assessment (Wrigley, 2005). Educationally, flow has also been positively correlated to learning, engagement (Shernoff, Csikszentmihalyi, Schneider & Shernoff, 2003), and achievement (Hood, 2007; Cartwright, 2006; Danehy, 2006).

Flow in Technology Environments

Over the last 15 years, researchers have studied and written about how flow is experienced within computer-mediated environments (Sedig, 2007; Finneran & Zhang, 2003; Koufaris, 2002; Venkatesh & Davis, 1996). Using flow as the theoretical foundation for exploration, play, and online engagement, it has been studied in the hypermedia learning environment (Konradt, Filip & Hoffman, 2003) and in digital game-based learning design (Kiili, 2005).

The aforementioned research results all indicate a positive relationship between flow and achievement as well as the transference of flow into a wide variety of settings from traditional to 2D web-based platforms. Yet, despite these findings, there exists no empirical research that has studied flow as an engagement framework within a 3D virtual environment.

These 3D environments offer much to be studied because of the potential to possibly create an engaging learning experience. The use of avatars may lead to an increased sense of identification; 3D visualization capabilities may lead to a greater sense of immersion; and direct manipulation of objects may lead to an increased sense of control – all of which are underlying dimensions of Flow theory.

Dede (2009) suggests that immersion in a digital environment can enhance education in at least three ways: by allowing multiple perspectives, situated learning, and transfer. His research suggests that these increasingly prevalent types of media, such as virtual worlds like Second Life, can aid in designing educational experiences that build on students' digital fluency and promote engagement, learning, and transfer from the classroom to real-world settings.

This research study purposefully examined two methods for assessing learning potential. The first method queried for fact and content retention, targeting the declarative domain through recall and recognition. The second method employed an open-end performance-based deliverable; examining less direct aspects of learning potential including quality of work, creativity, innovation, and the ability to follow directions. Assessing and measuring across two learning domains allowed for a more comprehensive examination of individual attainment.

Following the suggested evidence, it can be surmised that more engaged students may remember more, and subsequently, increased learning would be reflected in achievement through recognition and recall testing. Additionally, more engaged students may contribute more and participation would be reflected in performance-based testing.

Thus, the following two hypotheses were examined:

Hypothesis 1: There is a positive relationship between learners' level of engagement as measured by Flow theory and achievement in the 3-dimensional virtual learning environment of Second Life.

Hypothesis 2: There is a positive relationship between learners' level of engagement as measured by Flow theory and performance in the 3-dimensional virtual learning environment of Second Life.

METHOD

This research study focused on individuals who were using Second Life affiliated with education in some capacity. This included students, instructors, administration, and educational researchers who were current using Second Life as they already had access, had successfully logged on, and had basic navigational skills mastered. Volunteers had to be 18 years of age. An invitation was sent in Second Life inviting interested residents to participate in a study and an online registration web site was used to log interested volunteers. Volunteers were offered $20 (US) for their participation.

The research exercise consisted of volunteers who participated in a registration questionnaire, an exploration activity, and a post-activity questionnaire. The
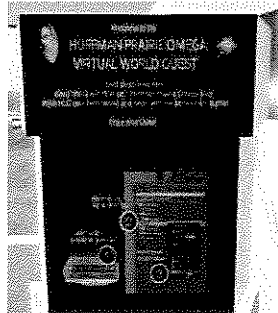
activity design was taken from the 2D WebQuest instructional design (Dodge, 1995); a self-directed, resource-ready, exploratory activity. WebQuests are an inquiry-based approach to addressing standards that place emphasis on motivation and authentic assessment by combining Internet resources with web applications (Dodge, 1995). Following the proven construct of the WebQuest, a Virtual World Quest or VWQuest, was designed. It followed the same Introduction, Task, Process, Resources, Evaluation and Conclusion format of a 2D WebQuest.

The activity was presented as a quest in which the participants were asked to gather information about a new technology-rich, instructional area named Huffman Prairie Omega in Second Life. Huffman Prairie Omega was designed by the U.S. Air Force as a region developed to support scalability assessments and sustainability analysis for educational technology innovations (Strickler, 2009).

Participants were encouraged to proceed through each section of the VWQuest sequentially, yet each section was available for previewing in any order and as often as necessary. Each section was self-explanatory, enabling the participant to begin, explore, and complete the whole process without intervention. The activity was expected to take about an hour to complete, yet learners were informed to spend as long exploring as they preferred. Participants were asked to take snapshots (similar to a screen capture) of various places and activities as evidence of discovery. They were to add supporting text to the photo and email it to a designated address. These photos were collected and 'photo packages' were assembled for each participant.
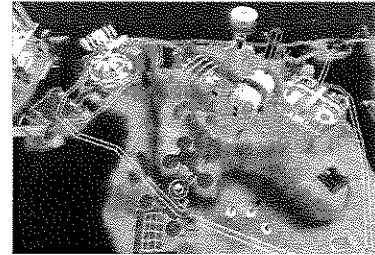
After exploring, participants took a multiple-choice knowledge-check quiz which served as the achievement assessment. Lastly, volunteers were directed to complete the online engagement survey. The survey used the nine dimensions of Flow theory to gather user-perceived levels of engagements while participating in the activity.

As previously mentioned, this study purposefully examined learning potential in more than one way, using both a declarative knowledge probe and a performance measure. The knowledge check queried for fact and content retention. The performance

measure provided an open-ended opportunity for willingness, immersion, and engagement to become evident by assessing many aspects including quality of work, creativity, innovation, and the ability to follow directions. Collectively, each participant had an opportunity to create a small portfolio of learning attainment, targeting more than one aspect of his or her abilities.

Based on the hypotheses, the research questions specifically examined the relationship if any, between (1) levels of engagement and achievement, and (2) levels of engagement and performance. Independent variables were engagement as measured by flow scores. The dependent variables were individuals' achievement as measured by knowledge-check scores, and performance as measured by photo package scores.

The study included a pilot test. The participants provided feedback on the technical functionality, structure, and content of the procedure. The instruments and activity were updated according to the formative feedback.

Data were collected through quantitative instruments including the registration questionnaire, the engagement survey, and the knowledge-check quiz. The registration questionnaire collected demographic and Second Life experience information. The knowledge check was an 11 question, multiple-choice quiz that targeted declarative information via recall. The quiz was developed and taken in Second Life. Quizzes were graded automatically and sent to a quiz collection email folder.

Engagement was measured using the Flow State Scale (FSS-2) survey. The instrument, developed by Jackson and Ecklund (2002), has been tested across many domains (Wrigley, 2005; Connolly, 2008; Mugford, 2006; Saville, 2006). The instrument has been validated and tested for reliability (Jackson & Ecklund, 2002). The survey was a 36 question, Likert-scale, subjective instrument containing questions that targeted the nine dimensions of flow four times each.

A performance rubric for assessing the participants' photo packages was developed. Five elements were used as criteria for evaluation. The two core criteria were quality and adherence; these were assessed on a five-point scale. Additional points were attainable for creativity, additional content, and additional photos; these were assessed on a three-point scale. Innovative packaging credit was also awards, worth a single point. The first two measures - quality and adherence - were worth five points because they were considered core or required measures. The second measures - creativity,

additional content, and additional photos - weighed slightly less because they were perceived as additional evidence of performance. The last measure - innovative packaging - was added during the rubric revision process when it was observed that, largely because of technology creativity, this should be addressed, albeit only to a small degree. The rubric, tested and evaluated by four independent evaluators, had an inter-rater reliability of k=.72 (considered *substantial*).

RESULTS

Two hundred participants registered for the activity. Of them, 112 finished the activity. Of those 112 participants, exactly 100 participants completed and submitted all of the requested data - registration questionnaire containing demographic data, knowledge check containing achievement data, photo packages containing performance data, and the flow survey containing engagement data. Demographics based on gender, age, country of origin, educational affiliation and Second Life skill level are provided in Table 1.

Table 1. Participant Demographics (N=100)

Demographic		Percent
	Male	40
Gender	Female	55
	Prefer Not to Answer	5
	18-29	20
	30-39	20
Age	40-49	26
	50-59	28
	60+	5
	Prefer Not to Answer	1
	Instructor	30
	Student	30
Educational Affiliation	Other	26
	Researcher	7
	Administrator	5
	Prefer Not to Answer	2
	Newbie	3
	Novice	15
SL Skill Level	Skilled	15
	Proficient	39
	Expert	28

Individuals ranged in age from 18 to over 60. The median age of participants was 40-49 years with most participants in the age range of 50-59. This serves as

evidence that the audience majority may have been an older, perhaps research-oriented, collection of teachers, faculty, and instructors versus a majority of younger, perhaps socially-oriented students.

The majority of participants were white and from the United States. Still, Second Life's global influence can be seen in the fact that respondents from 16 countries participated as well as the ethnicity diversity, with participants reporting White, Black, Hispanic, Asian and multi-cultural.

The median and mode report for Second Life skill level was 'Proficient' suggesting that that requirement for mastery of basic navigational skills was likely met. The data associated with engagement, (M=68.29, SD=14.11, N=100), achievement, (M=78.82, SD=14.74, N=100) and performance, (M=54.33, SD=17.43, N=100) are depicted as percentages in Table 2. Tests for outliers and normality indicate that there were no outliers and normality of the data could be assumed.

Table 2. Descriptive Statistics for Engagement, Achievement and Performance (N=100)

	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Engagement (percent)	68.2917	14.10619	-.046	.241	-.617	.478
Achievement (percent)	78.8197	14.73551	-.610	.241	-.320	.478
Performance (percent)	54.3332	17.42976	.234	.241	-.583	.478
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Engagement (raw)	.079	100	.132	.987	100	.439
Achievement (raw)	.181	100	.000	.918	100	.000
Performance (raw)	.110	100	.005	.971	100	.025

a. Lilliefors Significance Correction

The statistical test chosen was a simple regression. As both hypotheses are investigating relationships, a correlation test suggests relationship. As such, if two variables are correlated, then knowing the value of one variable will allow the prediction of the other variable. Regression is an extension of this principle (Brace, Kemp & Snelgar, 2006). All tests for significance were set at the .05 level.

Hypothesis 1

As a result of a simple regression test, hypothesis 1 was not supported. That is, there was not a statistically significant relationship, F (1,98)=2.1, $p>.05$, between engagement and achievement within the learning activity in Second Life as shown in Figure 1.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.144[a]	.021	.011	1.612

a. Predictors: (Constant), Overall Engagement

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.367	1	5.367	2.065	.154[a]
	Residual	254.743	98	2.599		
	Total	260.110	99			

a. Predictors: (Constant), Overall Engagment Score
b. Dependent Variable: Achievement

Figure 1. Regression Analysis of Achievement on Engagement

Only 1.1% of the variance in score can be accounted for by engagement. In practical terms, this suggests that for this study's activity, an individual's overall level of engagement was not able to statistically predict an individual's ability to achieve.

Hypothesis 2

Testing for engagement as a predictor of performance, hypothesis 2 was supported. That is, there was a statistically significant relationship, F (1,98)=14.17, $p<.01$, between engagement and performance within the learning activity in Second Life as shown in Figure 2. Exactly 11.7% of the variance in performance can be accounted for by engagement. In practical terms, this suggests that for this study's activity, an individual's overall level of engagement was able to statistically predict an individual's ability to perform.

The fact that hypothesis 2 was supported suggests that having an engaging experience while learning in an immersive 3D environment may in fact contribute to an individuals' ability to perform better.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.355ª	.126	.117	2.456

a. Predictors: (Constant), Overall Engagement

ANOVAᵇ

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	85.510	1	85.510	14.174	.000ᵇ
	Residual	591.240	98	6.033		
	Total	676.750	99			

a. Predictors: (Constant), Overall Engagment Score

b. Dependent Variable: Performance

Coefficientsª

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.003	1.651		1.213	.228
	Overall Engagement	.046	.012	.355	3.765	.000

a. Dependent Variable: Performance

Figure 2. Regression Analysis of Performance on Engagement

Additional Findings for Performance

Although engagement using flow constructs had been examined, there remained a significant amount of unexplained variance. It seemed possible that other factors had interacted. For example, it seemed plausible that a participant's ability to become engaged was dependent on skill level. To confirm this possible relationship, performance and engagement were regressed on Second Life skill. As Figures 3 and 4 indicate, Second Life skill level was found to be a statistically significant predictor of engagement, $F (1.98) = 5.336, p<.05$, but not performance, $F (1,98) = 1.289, p>.05$.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.227ª	.052	.042	19.882	.052	5.336	1	98	.023

a. Predictors: (Constant), Overall SL Skill Level

ANOVAᵇ

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2109.192	1	2109.192	5.336	.023ª
	Residual	38737.25	98	395.278		
	Total	40846.44	99			

a. Predictors: (Constant), Overall SL Skill Level

b. Dependent Variable: Overall Engagement

Coefficientsª

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	118.868	6.987		17.013	.000
	Overall SL Skill Level	4.137	1.791	.227	2.310	.023

a. Dependent Variable: Overall Engagement

Figure 3: Regression Analysis of Engagement on Second Life Skill Level

Engagement was previously found to be a statistically significant predictor of performance and thus, it followed that skill level helped predict engagement and

engagement helped predict performance. That is, engagement was found to be a mediator between skill level and performance.

ANOVAᵇ

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.783	1	8.783	1.289	.259ª
	Residual	667.967	98	6.816		
	Total	676.750	99			

a. Predictors: (Constant), Overall SL Skill Level

b. Dependent Variable: Performance

Figure 4: Regression Analysis of Performance on Second Life Skill Level

DISCUSSION

While the analysis found no statistically significant relationship between a participant's perceived level of engagement and their likelihood to achieve through recall, it did find a statistically significant relationship between a participant's perceived level of engagement and their performance levels. Possible explanations and amplifying information follows.

Although participants were requested to complete the knowledge check when they were finished exploring, many reported that if they didn't know an answer they left the knowledge-check quiz, found the answer, and then returned to answer the question. The process of 'finding' the answer while in mid-assessment may in fact have skewed the results. While learning isn't limited to a particular time while exploring, the broken concentration and re-direction of effort to find the answer could be considered disruptive to a flow experience. Therefore, the interruption to the learning sequence may serve as one possible explanation for the lack of relationship between engagement and achievement.

A positive relationship was found between engagement and performance. Upon observing the vast range of participants' performance responses, this relationship is especially interesting. Early in the research design, a performance rubric was developed to measure the range of photo packages expected. Inter-rater reliability was achieved and during the pilot test, the rubric served well. During the actual experiment however, a completely unexpected range of results was received. Though participants were asked to locate and take evidence photos of ten events, responses ranged from four to 74 photos. Some took photos with other people in Second Life. While some participants emailed their photos as directed, others created videos and other multimedia presentations using their photos. Furthermore, while the directions indicated the activity should take approximately an hour, participants

reported spending hours and days at the location. It quickly became apparent that there was a range of performance the original rubric was not able to capture. Thus the rubric underwent four revisions before it was perceived to measure the vast range of responses as well as achieve new inter-rater reliability between photo package evaluators. These findings suggest that open-ended and creative opportunities to perform, in fact, may yield higher levels of creativity, engagement, and innovation which are available in immersive platforms such as virtual worlds. These performance results are unexpected and reach far beyond that of traditional instructional settings.

Potential Outcomes

For educators and trainers, outcomes associated with potential engagement and performance have great value towards implementation, delivery, and integration of well-designed and delivered instructional content. Additionally, understanding the context of effective learning in advanced technology platforms is important since many systems in which millions of dollars are invested are rejected because of poor design and poor user interfaces (Venkatesh & Davis, 1996). This potentially translates to millions of tax payers' dollars.

For instructional designers, understanding design issues associated with complex platforms like Second Life and flow factors can contribute positively to the instructional design process. By understanding these environments, designers can create the most effective and efficient instructional designs. This in turn, helps alleviate and eliminate costly, frustrating and likely unused instructional content. For DoD, these potential outcomes are vital to remaining technology leaders in training our sailors and soldiers.

Limitations

The results of this research were limited to the virtual world of Second Life and to measuring engagement using only factors defined by Flow theory. The generalization of this study is limited to similar virtual world settings, with similar audience scope, measures and activity constructs. Additionally, while a representative sample was sought for the educational member resources, the true total education population of Second Life is not known.

Furthermore, Huffman Prairie Omega was not owned by the researcher and thus posed a few challenges. Although efforts were fully coordinated with owners and while issues were rare, a few items were hard to consistently control such as slow loading, missing

graphics, or extra content presented during a participant's activity times.

Lastly, virtual worlds are still considered a primitive technology. Despite a participant's skill level or hardware, intermittent Second Life performance issues may have surfaced affecting a participant's ability to succeed and/or engage. Because of these limitations, caution must be taken prior to generalization of any of the findings.

Conclusion

Virtual worlds, such as Second Life, are redefining the idea of "being there". These global 3D immersive environments attract people from all over the world to interact with one another in real-time, as well as to explore, manipulate and visualize. As such, virtual worlds have been labeled as a transformative development that will perhaps change the way we use the Internet over the next decade (Wyld, 2008).

Educational interest for effective teaching and learning is already profoundly evident, particularly for our military. General William Looney, USAF, has championed the US Air Force's efforts in virtual world exploration for training and education. His message which can be extended to our entire military is one of technological understanding and readiness, coupled with a thorough understanding of effective training and education in this new domain. To maintain our position as a respected and feared military in times of accelerating technological change, we need to be able to recruit the best and brightest young Americans – young men and women who have been living in a digital world their entire lives and are better prepared than previous generations to learn in this environment. It is vital that the students' expectations and needs help direct our approach to education and training (AETC, 2008).

This empirical study examined a topic of much interest and visibility. It is expected that this disruptive technology will continue to hold significant impact potential on student engagement, inquiry, achievement and performance. Second Life is a complex technology, one that is novel, illusive, and attractive, with learning implications empirically unknown at this time. Further research is needed to help identify additional relationships between learning content, learning interest, and these attractive yet challenging platforms, especially for the rapidly growing community of educators within virtual worlds.

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